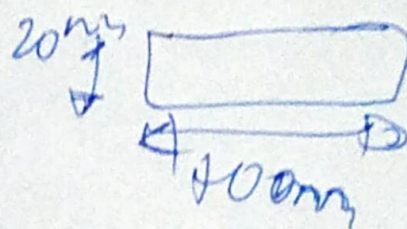
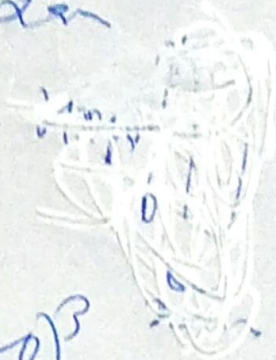
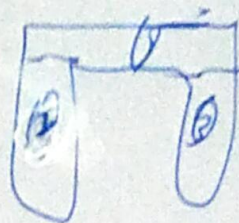


Daniel Lumb Vigners
 183878
 CR 5th May Exam
 Problem 1



$$I_x = \frac{(400)(20)^3}{12} = 0.2667 \times 10^6 \text{ mm}^4$$

$$I_y = \frac{(20)(400)^3}{12} = 106.667 \times 10^6 \text{ mm}^4$$

$$A = (400)(20) = 8000 \text{ mm}^2$$

Section	Area (mm ²)	I_x (10 ⁶ mm ⁴)	I_y (10 ⁶ mm ⁴)	Modulus Z_x (mm ³)	R_s (mm)
Web (mm ²)	8000	0.2667	106.667	200	1800

$$1.2 \theta_{\text{water}} = 59.21 = 0.018527 \text{ m}^3$$

$$\rho_{\text{water}} = 1000 \text{ kg/m}^3$$

$$W_{\text{water}} = \rho_{\text{water}}(g)(\theta_{\text{water}}) = (1000 \frac{\text{kg}}{\text{m}^3})(9.81 \frac{\text{m}}{\text{s}^2})$$

$$W_{\text{water}} = 185.6739 \text{ N} \times (0.018527 \text{ m}^3)$$

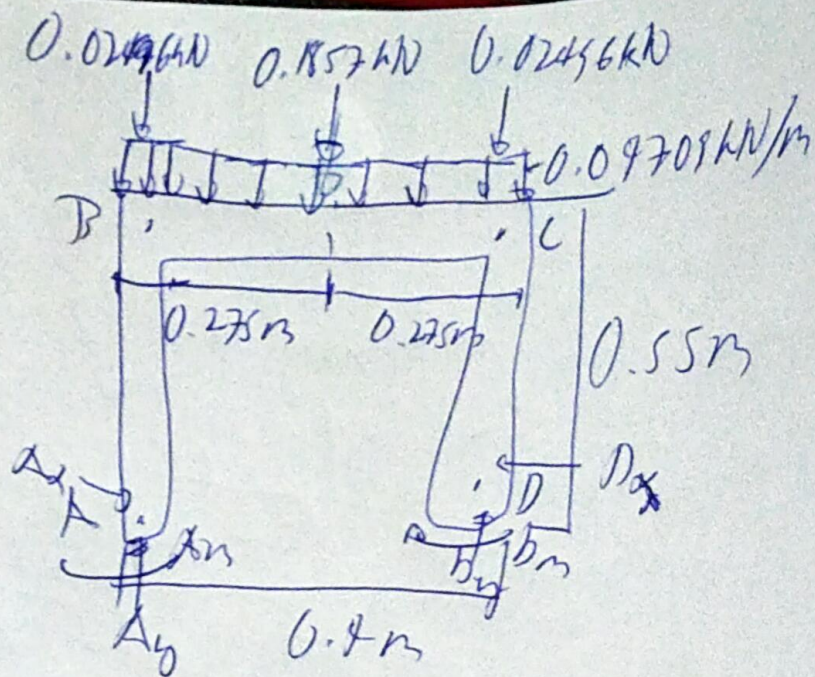
$$= 0.1857 \text{ kN}$$

$$\text{depth } L_z = 0.4 \text{ m} = 400 \text{ mm} = L_x$$

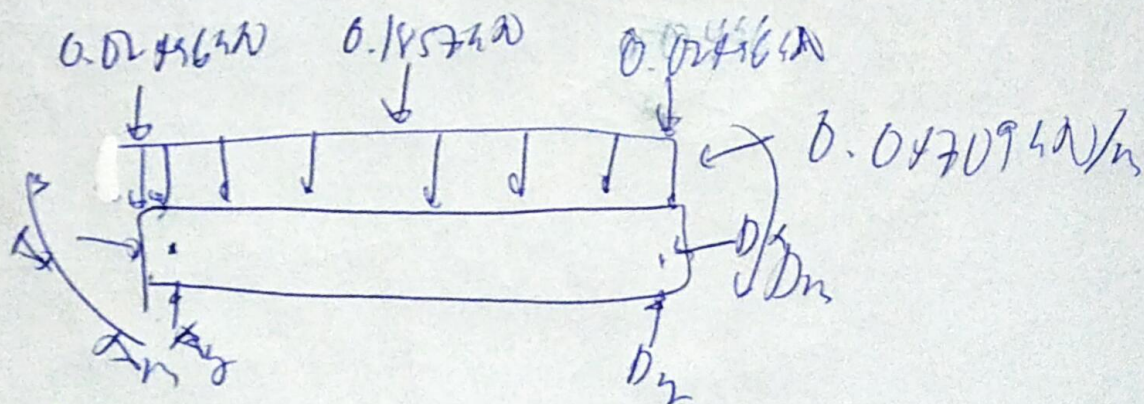
Label	Area (m^2)	Volume (m^3)	Weight (N)	Weight (kN)
1	0.008	0.032	1.92	0.01884
2	0.0106	0.0424	2.544	0.02456
3	0.0106	0.0424	2.544	0.02456

1 is distributed load!

$$\frac{0.01884 \text{ kN}}{0.4 \text{ m}} = 0.04709 \frac{\text{kN}}{\text{m}}$$



1.3



$$\sum F_x = 0 \Rightarrow A_x = D_x$$

$$M_{RD}^F = \left(\frac{(0.1857)(0.4)}{4} + \frac{(0.4709)(0.4)^2}{12} \right)$$

$$M_{RD}^F = 0.01556 \text{ kN-m} = -M_{AD}^F$$

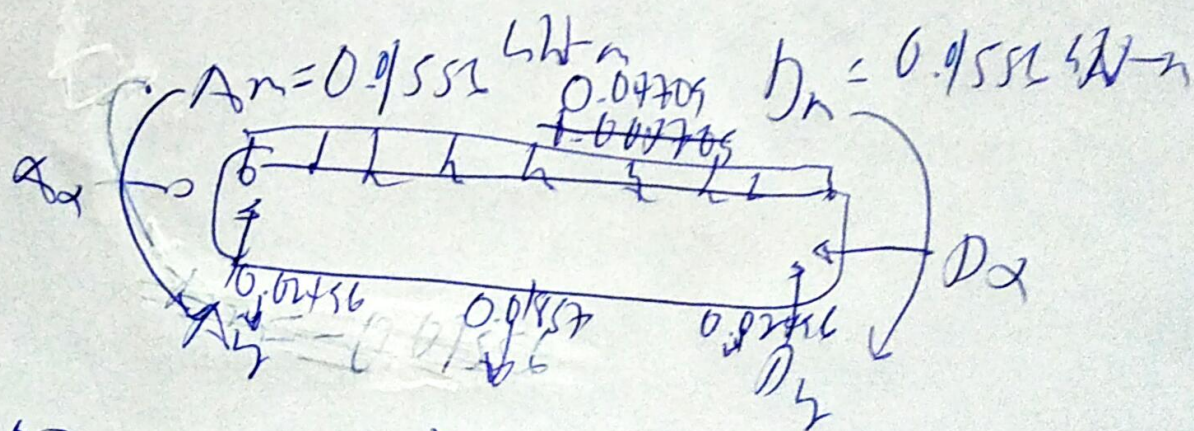
$$M_{AD} = M_{AB}^F + \frac{2EI}{L} (\cancel{2\theta_A} + \theta_B - 3\cancel{\Delta/L})$$

$$M_{BA} = M_{BA}^F + \frac{2EI}{L} (\cancel{2\theta_B} + \cancel{\theta_A} - 3\cancel{\Delta/L})$$

$$M_{AB} + M_{BA} = 0$$

$$\frac{2(9.8)(935.8)}{0.7} (\theta_B + 2\theta_B) = 0$$

$$\theta_B = 0$$



$$A_z + A_x = 0 = 0!$$

$$\cancel{A_z = 0!}$$

$$\cancel{M_z = -0.1556 + 0.01857}$$

$$\sum M_A = 0: \curvearrowright$$

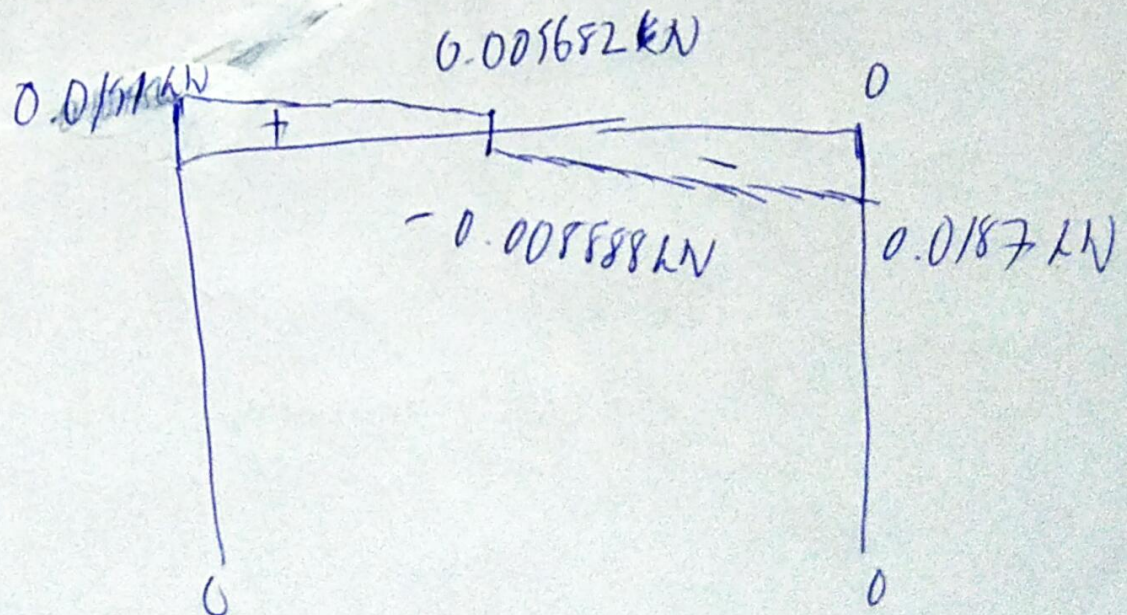
$$(0.01857)(0.2) + \cancel{0.0047} (0.04703)(0.2)(0.4)$$

$$+ 0.02746(0.4) - D_y(0.4) = 0$$

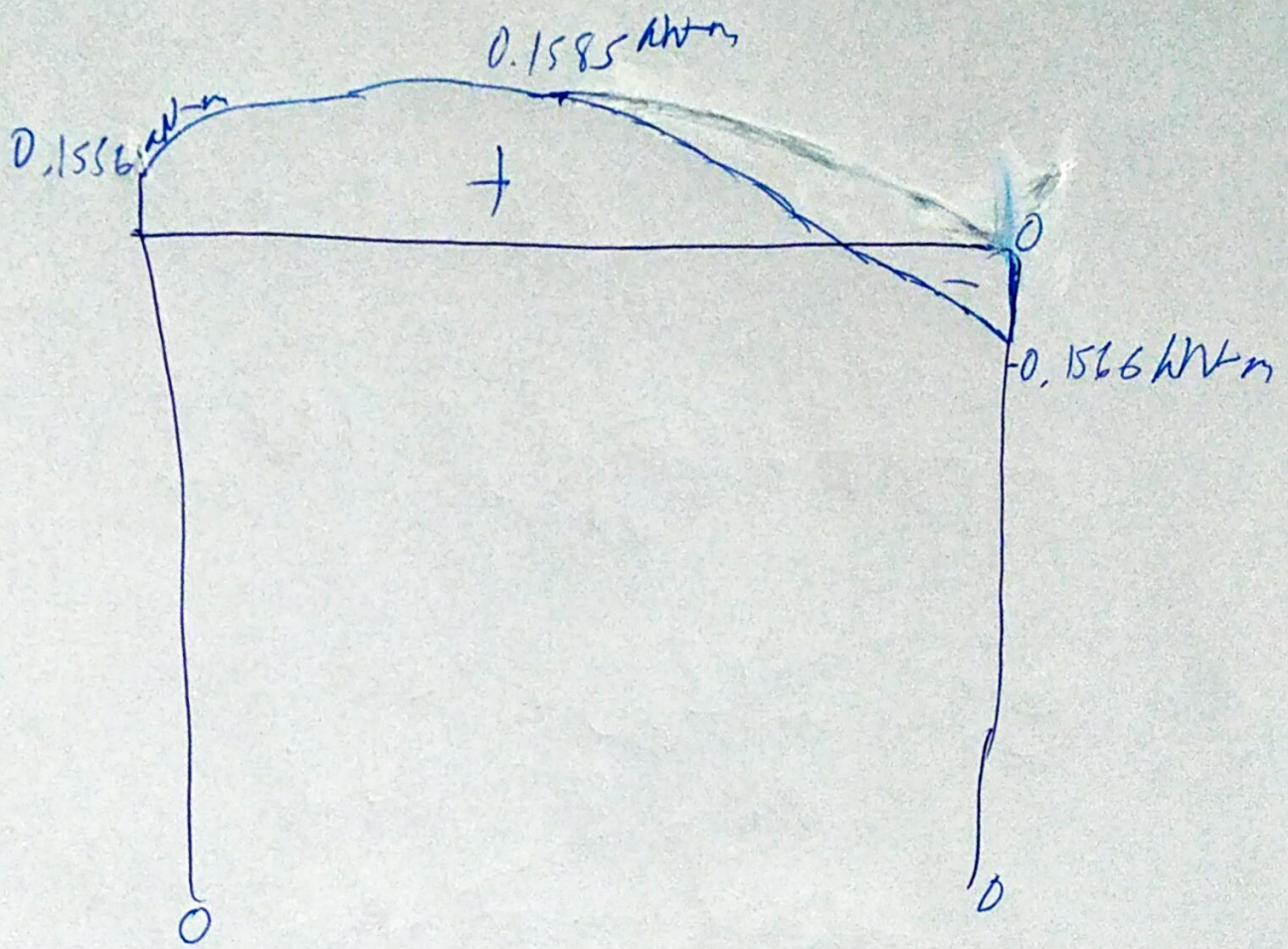
$$D_y = 0.04366 \text{ kN}$$

$$\sum F_y = 0 \Rightarrow D_y = 0.04366 \text{ kN}$$

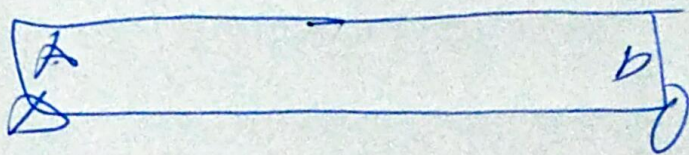
1.4 shear (kN)



moment! (kN-m)



1.6

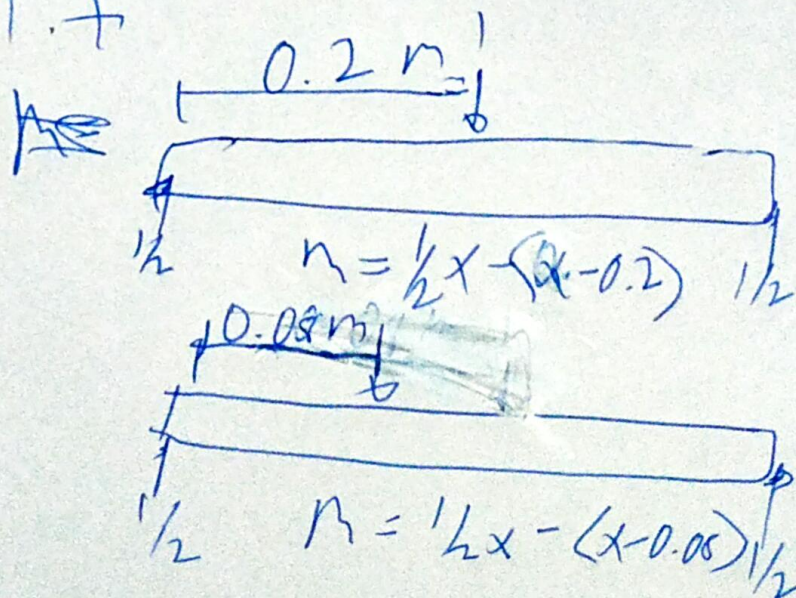


$$\Delta x = 0$$

$$\Delta y = 0.04366 \text{ kN} \uparrow$$

$$\Delta y = 0.04366 \text{ kN} \uparrow$$

1.7



$$M = -0.01566 + \frac{0.04366x}{2} - \frac{0.04705}{2}x^2 - 0.01857(x - 0.2)$$

$$\Delta = \int_0^L \frac{mM}{EI} dx$$

$$\Delta = \frac{1}{EI} \left(\int_0^{0.2} \left(\frac{1}{2}x \right) (-0.01566 + 0.4366x - \frac{0.64805}{2}x^2) dx \right. \\ \left. + \int_{0.2}^{6.4} \left(\frac{1}{2}x \right) (-0.01566 + 0.4366x - \frac{0.04705}{2}x^2 - 0.01566x) dx \right)$$

$$\Delta = \frac{0.0003784 + -0.002725}{(9.8)(935.8)}$$

$$\Delta = 405.1789 \times 10^{-6} \text{ m} = \boxed{0.4052 \text{ mm}}$$

1.8

$$\Delta = \frac{0.0001010 - 0.0003674 - 0.002725}{(9.8)(935.8)}$$

$$\Delta = -1.1945 \times 10^{-3} \text{ m}$$

$$\Delta = \boxed{-1.1445 \text{ mm}}$$

$$\boxed{-2.27 \text{ mm}}$$